Coyote
WATERSHED
Santa Clara Valley
Water District

Calera Creek
Reconnaissance Study

From
Berryessa Creek Confluence to I-680

Final Report

April 2004

SANTA CLARA VALLEY WATER DISTRICT

COYOTE WATERSHED PROGRAM

April 13, 2004

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1. EXECUTIVE SUMMARY

A reconnaissance level study of flooding along Calera Creek was performed to assess the existing level of flood protection and to determine if improvements to the existing flood walls and levees are necessary to achieve 1% (100-year) flood protection. Calera Creek, located in the City of Milpitas (Milpitas), CA, is a tributary to Berryessa Creek. This study investigates the segment of Calera Creek beginning at its confluence with Berryessa Creek and extending upstream to Interstate 680. Design drawings, FEMA floodplain maps, and maintenance records were reviewed, field investigations were conducted, and hydraulic analyses was performed to assess the level of flood protection under as-built and existing conditions. Hydraulic modeling was performed to quantify the capacity of the creek and to identify the flooding areas and water depths during the 1% flood.

The reader should note that the focus of this study was to investigate the hydraulic capacity of Calera Creek under existing Berryessa Creek conditions. The impacts to Calera Creek caused by a backwater effect resulting from levee improvements and a raised water surface elevation on Berryessa Creek will be addressed as part of the Lower Berryessa Creek planning study. Preliminary hydraulics indicate that the backwater effect will raise the water surface elevation on Calera Creek from the confluence with Berryessa Creek up to the drop structure (upstream of Arizona Avenue). Improvements to Calera Creek within this reach to mitigate for the increase in water surface elevation will be included in the Lower Berryessa Creek Project. Improvements to Calera Creek upstream of the drop structure are not included in the Lower Berryessa Creek Project.

It has been determined that the estimated 1% flood flow of 920 cfs cannot be conveyed within the Calera Creek channel while meeting the District freeboard guidelines. 1% flood flows are likely to overtop the channel immediately downstream of North Milpitas Boulevard, immediately upstream of the energy dissipating drop structure, Escuela Parkway, and the Pedestrian Bridge. Flows at the 1% level are generally contained within the channel in the rest of the creek, though freeboard requirements are not met along the majority of its length.

Potential channel improvements were identified to convey the 1% flow while meeting the District freeboard guidelines. Such improvements would also meet FEMA requirements for “re-mapping”, and therefore, remove properties within Calera Creek’s floodplain. The proposed improvements are summarized in Table ES-1.

The total project cost[1] depends on the alternative selected for Reach 5. The total project cost for Option A, replace existing energy dissipater in Reach 5, is approximately $5.0 million. The project cost for Option B, keep the existing energy dissipater and raise the levee and floodwall upstream higher than what would be needed for Option A, is $4.4 million. A more detailed breakdown of costs by reach is included in Appendix B.

Maintenance, particularly sediment removal, will prevent further reduction of freeboard in portions of the channel, however, prevention of overtopping under existing creek conditions cannot be achieved solely by sediment removal.

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[1] Total Project Cost includes planning, design, construction, inspection, and CEQA/permitting.

Table ES 1: Proposed Improvements to Restore 1% Flood Protection

Reach	Project Component	Existing Capacity [1] (cfs)
2	Increase wall height of U-frame channel downstream of N. Milpitas Boulevard	Zero due to Berryessa Creek influence [2]
3	Raise levees by one foot along both sides of channel	750
4	Raise levees by one foot along both sides of channel	900
5	**(A)** - Replace energy dissipation drop structure, raise levee by 2 feet, add floodwall OR **(B)** - Raise levee by three feet, add floodwall	Less than 200
6	Raise south headwall and maintenance road just upstream of Escuela Parkway	450
7	Parapet headwall and raise maintenance road upstream of pedestrian bridge	425

Table ES-1 Notes:

1. Existing Capacity based on flow depth at minimum freeboard guidelines listed in the District's freeboard criteria. Does not account for sediment deposition and vegetal growth.
2. The backwater effect during a 1% event in Berryessa Creek would overtop the channel even with zero flow from Calera Creek..

2. INTRODUCTION

This Reconnaissance Study (Study) has been commissioned because of concerns that Calera Creek, in its current condition, may lack the hydraulic capacity to convey a 1% flow event of 920 cfs. The Study summarizes historical channel modifications, documents the existing conditions, evaluates the hydraulic capacity, and proposes improvements for Calera Creek. It has been determined that the creek lacks capacity in certain locations. Improvements to increase the creek capacity have been identified and conceptual cost estimates have been developed.

3. CREEK DESCRIPTION BY REACH

Calera Creek is a small stream located in northern Santa Clara County, and is a tributary to Berryessa Creek. The stream originates in the hills northeast of the City of Milpitas (Milpitas) just south of Monument Peak at elevation 2,400 feet. From this point it flows in a generally southwesterly direction for four miles across Milpitas to its confluence with Berryessa Creek (District, 1993). Figure 1 shows the creek in its current alignment within Milpitas.

Calera Creek from approximately I-680 to Berryessa Creek was originally designed in 1969 for a 1% flood event of 750 cfs. In 1978, the District adopted new design flows for Calera Creek which were estimated at 920 cfs. All references to the 1% event in this report are for the 920 cfs flow unless otherwise noted. Channel cross section surveys at Escuela Parkway and North Milpitas Boulevard were collected in October 2002 to assist in the hydraulic modeling of existing conditions in these two reaches of the creek. All references to existing conditions are for the status of the creek in October 2002. All reference to left and right in this report are as seen facing downstream. A chronological synopsis of notable events and investigations in the development of Calera Creek is presented in Appendix A. Cost estimates are presented in Appendix B. A technical memorandum with detailed hydraulic modeling results is included as Appendix C. The modeling results as applicable to each reach are summarized below. A collection of photographs of the creek at various locations is presented in Appendix D. The District freeboard requirement of 4 feet within 100 feet of bridges and other constrictions within leveed sections is implied though not specifically mentioned within each general reach description. The freeboard requirement also states that where two-tenths of the specific energy (depth of flow plus [v2/2g]) is greater than 3.5 feet in leveed sections, the larger amount of freeboard shall apply. Hydraulic analysis of Calera Creek reveals that 3.5 feet is larger than the specific energy criterion in all reaches.

Field walks were conducted in May and August of 2001. Observations regarding sediment in the channel were based on field walks only and, since no elevation surveys were conducted at the time of the observations, this should be considered a qualitative assessment of sediment accumulation in the creek. Unless otherwise noted, all field observations documented in this memorandum were based on the May and August 2001 field walks.

Table 1 summarizes the reach designations utilized for this study. The location of each reach is identified on Figure 1, Map of Calera Creek. Each reach is bounded by structures such as road crossings. The reach designations presented in this report may not be consistent with reach designations of past documentation.

Table 1: Calera Creek Reach Descriptions

Reach	From	To	Station Range [1]	Length (feet)	Channel Type	Notes
1	Berryessa Crk	D/S UPRR	0+00 to 1+75	175	Natural Earth	Sediment and plant accumulation
2	D/S UPRR	U/S North Milpitas Blvd.	1+75 to 9+00	725	Concrete U-Frame	Sediment and plant accumulation
3	U/S North Milpitas Blvd.	U/S Arizona Ave.	9+00 to 23+00	1,400	Earth Trapezoid	Sediment and plant accumulation
4	U/S Arizona Ave.	D/S Drop Structure	23+00 to 30+80	780	Earth Trapezoid	Sediment and plant accumulation
5	D/S Drop Structure	D/S Escuela Parkway	30+80 to 41+00	1,020	Managed Floodplain	Sediment and plant accumulation. Heavy bush & tree growth. Past flooding.
6	D/S Escuela Parkway	D/S Pedestrian Bridge	41+00 to 53+20	2,220	Gully	Sediment and plant accumulation at downstream end.
7	D/S Pedestrian Bridge	U/S I-680	53+20 to 66+00	1,280	Gully	Incised channel with steep slope.
8	U/S I-680	Milpitas City Limit	66+00 to 75+00	900	Gully	Incised channel with steep slope.

Notes:
U/S – Upstream
D/S – Downstream
1. Station numbers are approximate

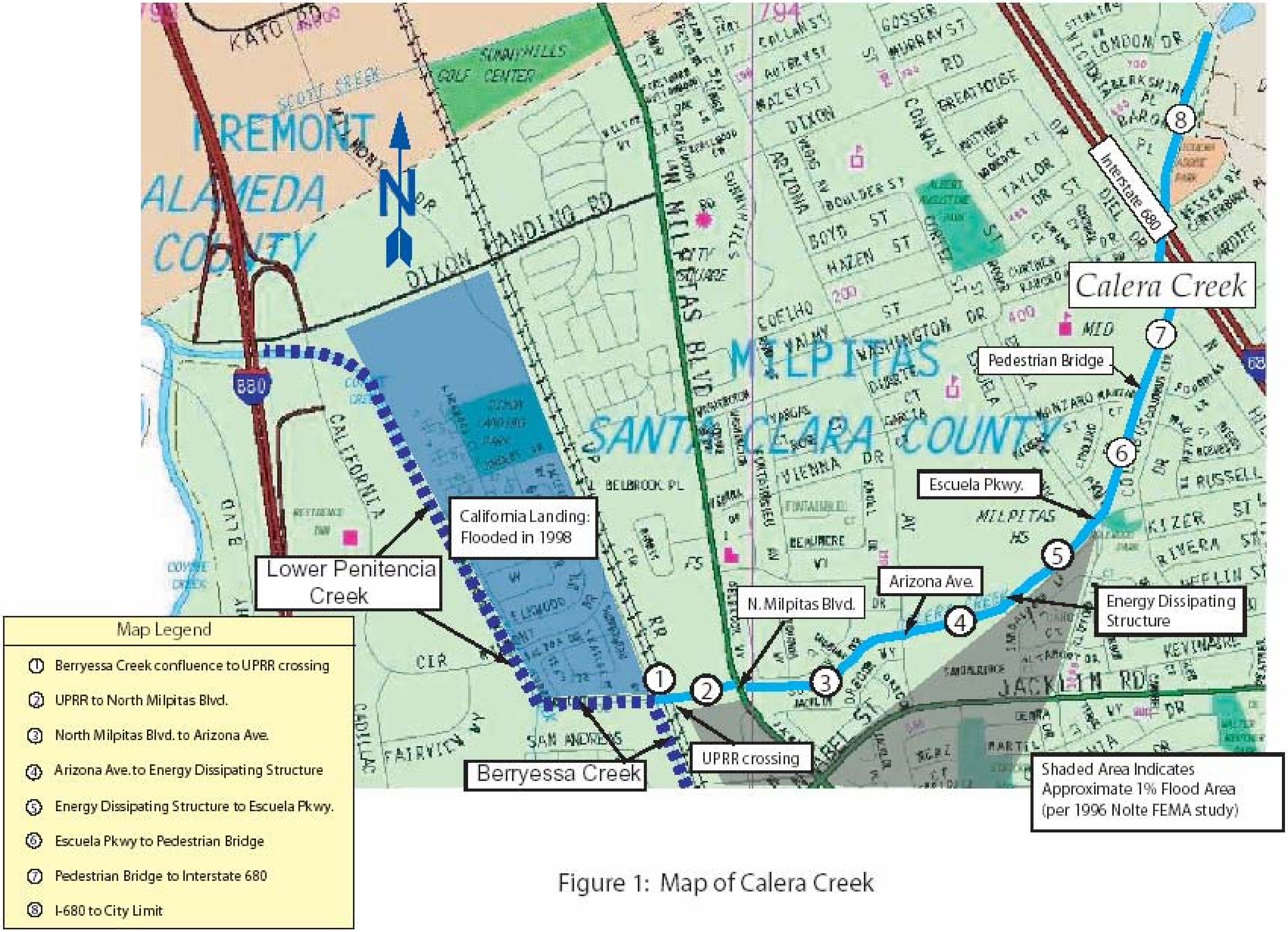
FREMONT
ALAMEDA COUNTY
MILPITAS
SANTA CLARA COUNTY
N
Calera Creek
Interstate 680
Pedestrian Bridge
Escuela Pkwy.
Arizona Ave.
Energy Dissipating Structure
N. Milpitas Blvd.
UPRR crossing
Berryessa Creek
Lower Penitencia Creek
California Landing: Flooded in 1998
Shaded Area Indicates Approximate 1% Flood Area (per 1996 Nolte FEMA study)
880
Map Legend
① Berryessa Creek confluence to UPRR crossing
② UPRR to North Milpitas Blvd.
③ North Milpitas Blvd. to Arizona Ave.
④ Arizona Ave. to Energy Dissipating Structure
⑤ Energy Dissipating Structure to Escuela Pkwy.
⑥ Escuela Pkwy to Pedestrian Bridge
⑦ Pedestrian Bridge to Interstate 680
⑧ I-680 to City Limit

Figure 1: Map of Calera Creek

3.1 Reach 1: Berryessa Creek Confluence to Union Pacific Railroad tracks (Station 0+00 to 1+75)

This reach is an earthen channel approximately 175 feet long. Sacked concrete has been used for slope protection at the outlet structure of the railroad crossing and at the confluence with Berryessa Creek.

On February 3, 1998, precipitation from a storm of an approximate 10-year return frequency caused flooding in several locations throughout Santa Clara County (Schaaf & Wheeler, 1998). During high tide in San Francisco Bay, water from Berryessa Creek backed up into Calera Creek and overflowed through a low point in the levee adjacent to the Union Pacific Railroad (UPRR) tracks (see Photograph 1 in Appendix D). Water from this levee breach and a coincident failure of a stormwater pump station caused flooding of up to four feet in the California Landing area of Milpitas.

In response to this flooding, the Santa Clara Valley Water District (District) implemented a plan to correct the problem. An emergency sandbag levee built the day of the flood was replaced in the summer of 1998 with a temporary levee consisting of 200 feet sand bag structure covered with shotcrete. A permanent floodwall was constructed in 2002 as part of the Calera Creek Floodwalls and Access Bridge Project[1] (See Photograph 2 in Appendix D). Sediment was also removed from the channel during the floodwall construction.

Hydraulic Analysis

In order for the freeboard requirement of 3.5 feet to be met, the floodwalls would need to be raised approximately 0.5 feet, and approximately 300 lineal feet of levee in this area would need to be raised an average of approximately 2 feet.

3.2 Reach 2: Union Pacific Railroad to North Milpitas Boulevard (Station 1+75 to 9+00)

The UPRR crossing upstream of Berryessa Creek consists of a double 11-foot by 6-foot reinforced concrete box culvert 150 feet in length. The downstream end is shown in Photograph 2 in Appendix D. The structure is designed to operate under slight pressure head during a 1% flood event (SCVFC&WD, 1969). Taller culverts that would allow for a free water surface during a 1% flood were not constructed because of the cost associated with raising the overlying railroad tracks. Field observations indicated that sediment within the culvert was less than one foot deep.

Upstream of the railroad tracks is a concrete U-frame channel that extends to North Milpitas Boulevard. Most of the 725-foot long U-frame is 20 feet wide by 12 feet high. However, immediately downstream of North Milpitas Boulevard, the wall height decreases from 12 feet to 9 feet. Approximately 90 feet of the U-frame channel height ranges from 9 feet to 11.25 feet. Field observations in August 2001 indicated that sediment in the channel ranged from one to three feet deep. A variety of marshy plants up to five feet tall were growing in the sediment (See Photograph 3 and Photograph 4 in Appendix D). The channel was clear in August 2003.

A double 10-foot by 8-foot reinforced concrete box (RCB) culvert crosses under North Milpitas Boulevard. In August 2001 the north cell of the 125-foot long culvert contained sediment approximately two feet deep, though no plants were growing in it. The south cell had sediment approximately one foot deep. The District clears this reach of sediment approximately once every two years. In September of 2001, approximately 600 cubic yards of sediment were removed from Reach 2 (CRWQCB, 2001).

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[1] Engineer's Report, Santa Clara Valley Water District, February 2001.

Hydraulic Analysis

Hydraulic modeling indicates that the 1% flow in this reach would overtop the channel in the 90 foot length of the U-frame where the wall is only 9 feet high. If this portion of the U-frame channel matched the 12-foot height along the rest of its length, the 1% flow would be conveyed, though there would not be sufficient freeboard. The 100-year flow rate of 920 cfs will create a maximum depth of about 10 to 10.5 feet due to the 100-year starting water surface elevation of 18.75 feet (NAVD 88) in Berryessa Creek. In order to convey the 1% flow with the required 3.5 feet of freeboard, the height of the entire length of the U-frame channel would need to be raised to approximately 14 feet in height.

3.3 Reach 3: North Milpitas Boulevard to Arizona Avenue (Station 9+00 to 23+00)

This reach is a meandering, trapezoidal earthen channel with a designed bottom width of 10 feet, a depth of approximately 11 feet, 2:1 side slopes, and a channel slope of 0.002. The road crossing at the upstream end of this reach is a double 8 foot by 8 foot reinforced concrete box culvert under Arizona Avenue.

Both the north and south cells of the Arizona Avenue culvert contained less than one foot of sediment. August 2001 field observations indicated moderate sediment deposition and plant growth along the entire reach, though it was difficult to distinguish between deposited sediment and the engineered channel bottom and sides (see Photograph 5 in Appendix D). In the summer of 2002, the District removed sediment from the channel, re-graded the banks, and returned this reach of the channel to nearly “as built” conditions.

Hydraulic Analysis

Hydraulic modeling indicates that this reach can convey the 1% flow without overtopping the channel, but the water surface encroaches into the freeboard. Therefore, the levee height within this reach should be raised by approximately 2.5 feet to provide the District required 3.5 feet of freeboard.

3.4 Reach 4: Arizona Avenue to Energy Dissipator Drop Structure (Drop Structure) (Station 23+00 to 31+00)

This reach is a trapezoidal earthen channel with a designed bottom width of 10 feet, a depth of approximately 11 feet, 2:1 side slopes, and a channel slope of 0.005. In August 2001, this reach had large bushes and thick grass growing along the bottom and sides (see Photograph 6 and Photograph 7 in Appendix D). The upstream end is delineated by a 10-foot tall United States Bureau of Reclamation (USBR) energy dissipator drop structure (see Photograph 8 and Photograph 9 in Appendix D). The drop structure is the upstream limit of the tidally influenced portion of Calera Creek during high flows.

In the summer of 2002, the District removed sediment from the channel, regraded the banks, and returned this reach of the channel to nearly “as built” conditions.

Hydraulic Analysis

Hydraulic modeling indicates that this reach can convey the 1% flow without overtopping, however there would be only 0.5 feet of freeboard. In order to provide the required 3.5 feet of freeboard, the levees would need to be rasied by approximately 3 feet.

3.5 Reach 5: Drop Structure to Escuela Parkway (Station 30+80 to 41+00)

This 1,020-foot long reach is an earth lined channel that meanders within a 130-foot wide District easement. The slope of the channel is approximately 0.018. The District classifies this reach as a managed floodplain with a bottom width of 75 feet with 3.5:1 side slopes. The creek is bordered by Milpitas High School to the north and private residences on the south side of the creek. A raised maintenance road/levee with a top width of 10 feet runs along the south bank of the creek and was designed to be approximately four feet above the floodplain.

The two photographs (taken in 1984 and August 2001) in Figure 2 show this reach as seen facing downstream from Escuela Parkway. The orchard to the left of the raised maintenance road shown in the top photograph was replaced by 2-story residences on Sandalwood Lane, shown in the bottom photograph. Several trees have grown and thrived in this reach, as shown in the photograph taken in 2001. The unplanned presence of these trees increases channel roughness and decreases conveyance capacity.

In 1969, the planned channel configuration for this reach was a rectangular 10-foot by 8-foot concrete U-frame, though it was not constructed in favor of a natural floodplain with a meandering low flow channel. In 1995, the low flow channel was approximately three feet wide by two feet deep with thick grass covering nearly 100% of the sediment (District, 1997).

In 1996, Nolte and Associates, Inc. performed a hydraulic analysis of Calera Creek for the City of Milpitas as part of a submittal to the Federal Emergency Management Agency (FEMA). This study determined that during the 1% flood event, water overtops the maintenance road along the south bank of the channel and continues as sheet flow across a large portion of the city affecting several hundred homes and businesses (Nolte & Associates, 1996). An independent hydraulic analysis performed by the District in 2001 yielded similar results, including partial flooding of the high school along the north bank. Unlike the south bank in this reach, no raised maintenance road separates the high school from the creek.

Because the land in this area slopes downward from northeast to southwest, water that leaves the north bank of Calera Creek tends to pond in the high school area and then return to the main channel downstream. Water that leaves the south bank tends to continue southward as sheet flow and does not return to the main channel (see Figure 3 for illustration).

According to 1997 survey information provided by the District and August 2001 field observations, the houses at the upstream end of Reach 5 appear to be built on land that is at a lower elevation than the low flow channel of Calera Creek. The raised maintenance road is the only physical barrier that prevents high flows from inundating the residences to the south and west (see Figure 4).

In late 1997, District maintenance crews widened the low flow channel from approximately five feet to eight feet and deepened it to approximately three feet. Four months later, on February 3, 1998, the 10-year rainfall event that flooded the California Landing area caused Calera Creek to overflow its north bank in this area. Water briefly flowed along the southern edge of Milpitas High School, parallel to the creek, before rejoining the creek near the drop structure (Personal communication with District staff, 2001). Since the 1997 channel excavation, sediment and plants appear to have re-accumulated.

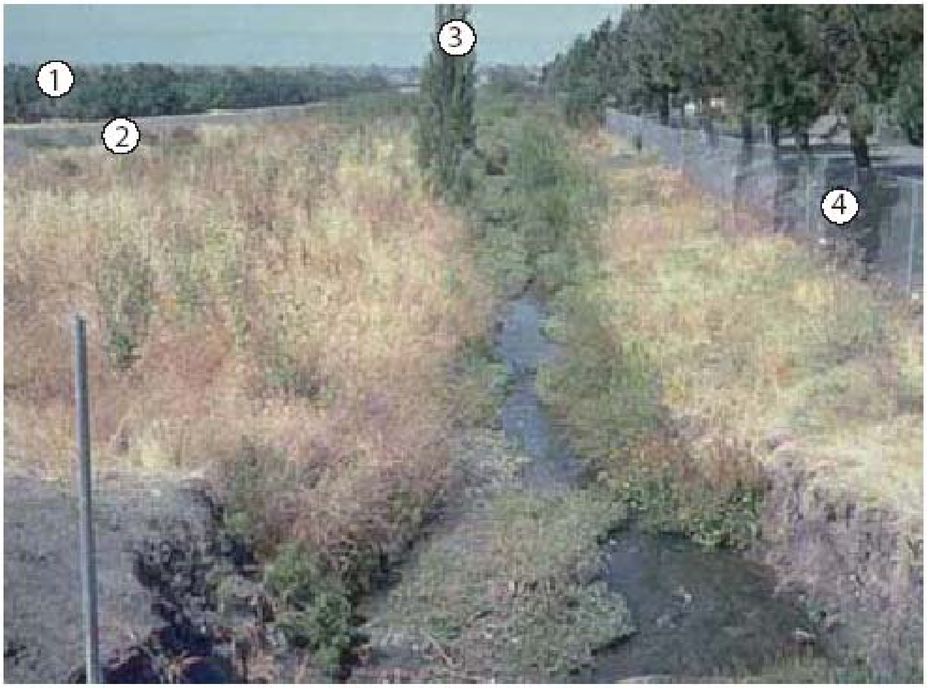
Hydraulic Analysis

Hydraulic modeling indicates that flooding in this reach is primarily caused by the high elevation of the pool that is formed immediately upstream of the drop structure. This flood pool overtops the maintenance road levee and floods surrounding residences. Calera Creek's 1% design flow water surface elevation (WSE) was calculated for "As-built" and existing conditions. The "As-built" hydraulic model was developed using design drawings for channel geometry and dimensions for each structure in the channel. In this reach, the 1% design flow WSE profile for existing conditions was roughly similary to the "As-built" profile, since both are controlled by the drop structure conditions. However, the lower top of levee elevations in the existing conditions model created lower capacity conditions and levee overtopping at lower flow rates.

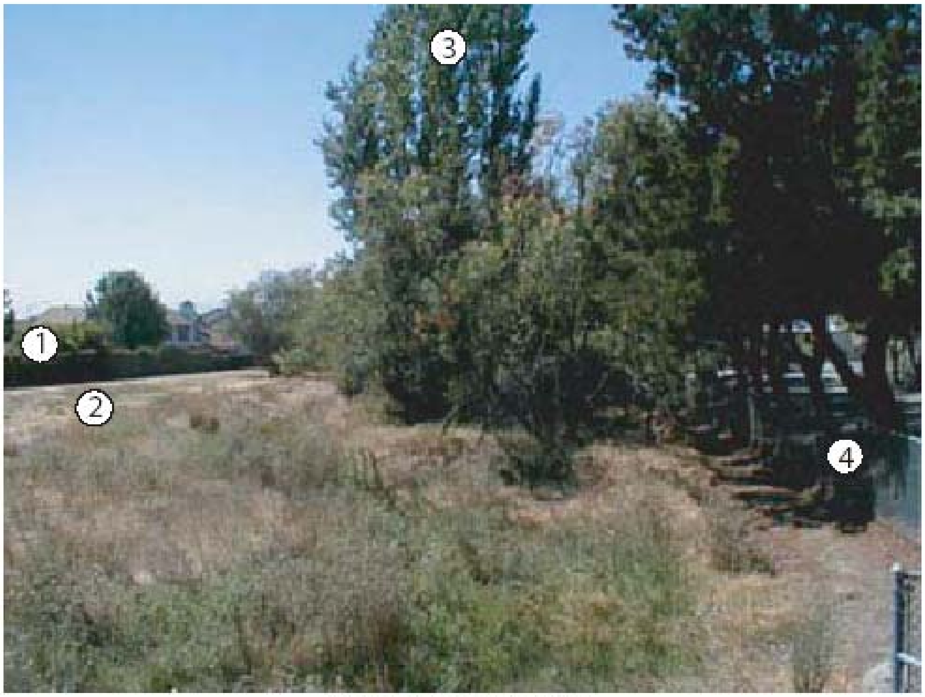
Review of the survey cross sections indicates that the two general areas where the most significant amount of sediment deposition has occurred includes 1) near the drop structure, and 2) immediately downstream of the Escuela Parkway culverts. The deposition at the drop structure is probably due to the slow velocity created by the flood pool, allowing sediments to drop out. Flow in this reach goes from supercritical to subcritical just upstream of the drop structure due to the flood pool created at the structure spillway. Approximately one to 2.5 feet of sediment has deposited upstream of the drop structure, resulting in an irregularly shaped conveyance channel. Downstream of the Escuela Parkway culverts, the flow area is greatly increased, allowing the depth to become much shallower, which also reduces the velocity at that location.

Hydraulic modeling indicates that the capacity in this reach was less than 200 cfs when a 3.5 feet freeboard requirement was used. If the levees were at the higher "as-built" condition elevations, the capacity of the reach would be about 300 cfs at 3.5 feet freeboard.

When the water surface elevation encroaches into the freeboard and rises to an overtopping condition, approximately 750 cfs can be conveyed through the drop structure. Modifications to the drop structure that reduce the pool level or increases in levee height by 3 feet, as well as floodwalls 3 feet in height along the north side of the channel, would be necessary to increase the capacity to 920 cfs with freeboard. Additional channel maintenance, such as sediment removal, will not impact the flood pool level at the drop structure, and will not reduce the flooding there. The channel maintenance will be necessary to maintain the freeboard along the channel, assuming that a 3.5 foot minimum freeboard would be required for the leveed section.



Photograph from 1984



Photograph from 2001

① Site of Sandalwood Residential Units
② Raised Maintenance Road
③ Poplar-type Tree
④ Fence along Milpitas High School

Figure 2: Reach 5 of Calera Creek in 1984 and 2001

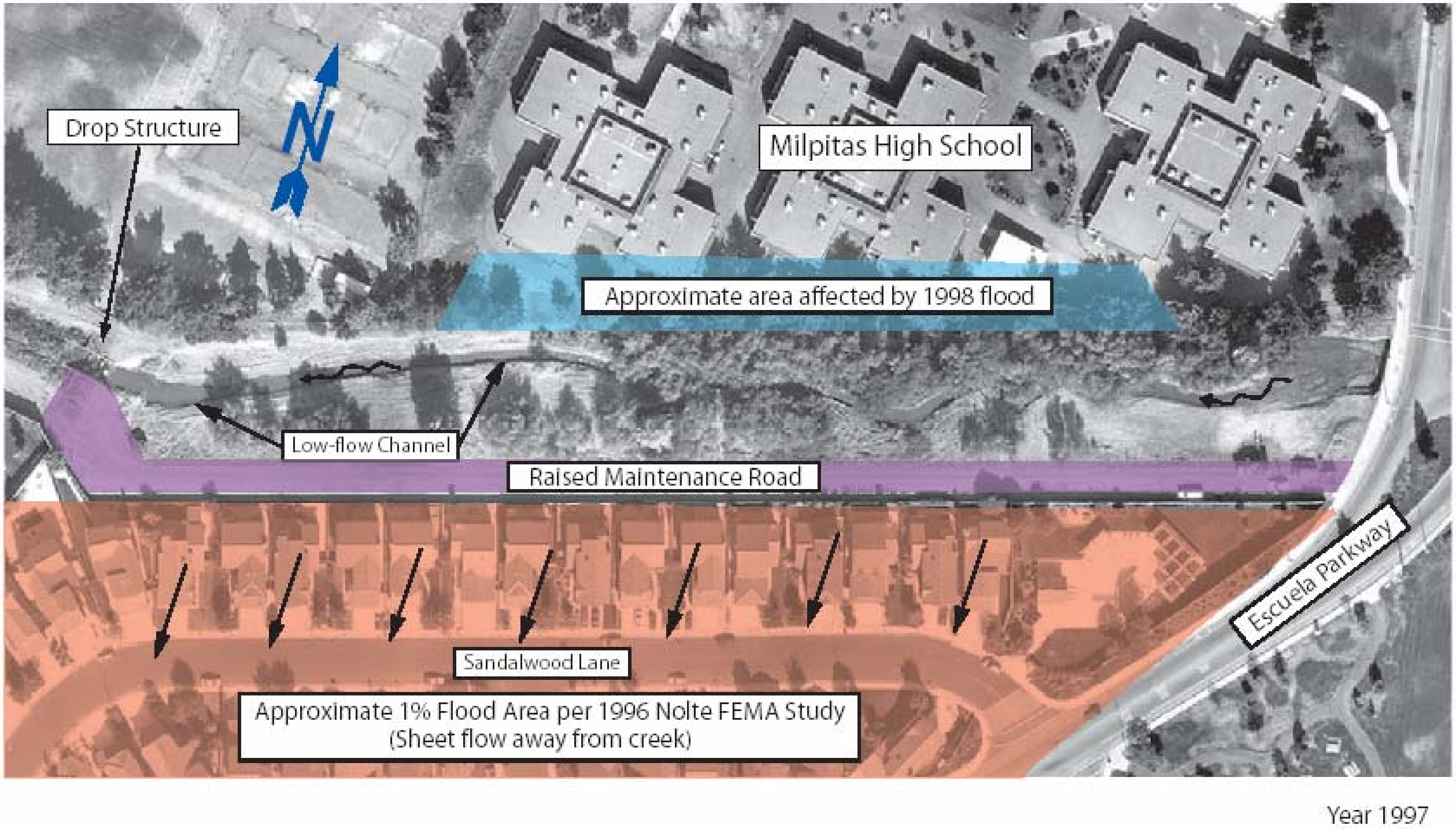

Drop Structure
N
Milpitas High School
Approximate area affected by 1998 flood
Low-flow Channel
Raised Maintenance Road
Escuela Parkway
Sandalwood Lane
Approximate 1% Flood Area per 1996 Nolte FEMA Study
(Sheet flow away from creek)
Year 1997

Figure 3: Aerial Photograph of Reach 5 of Calera Creek

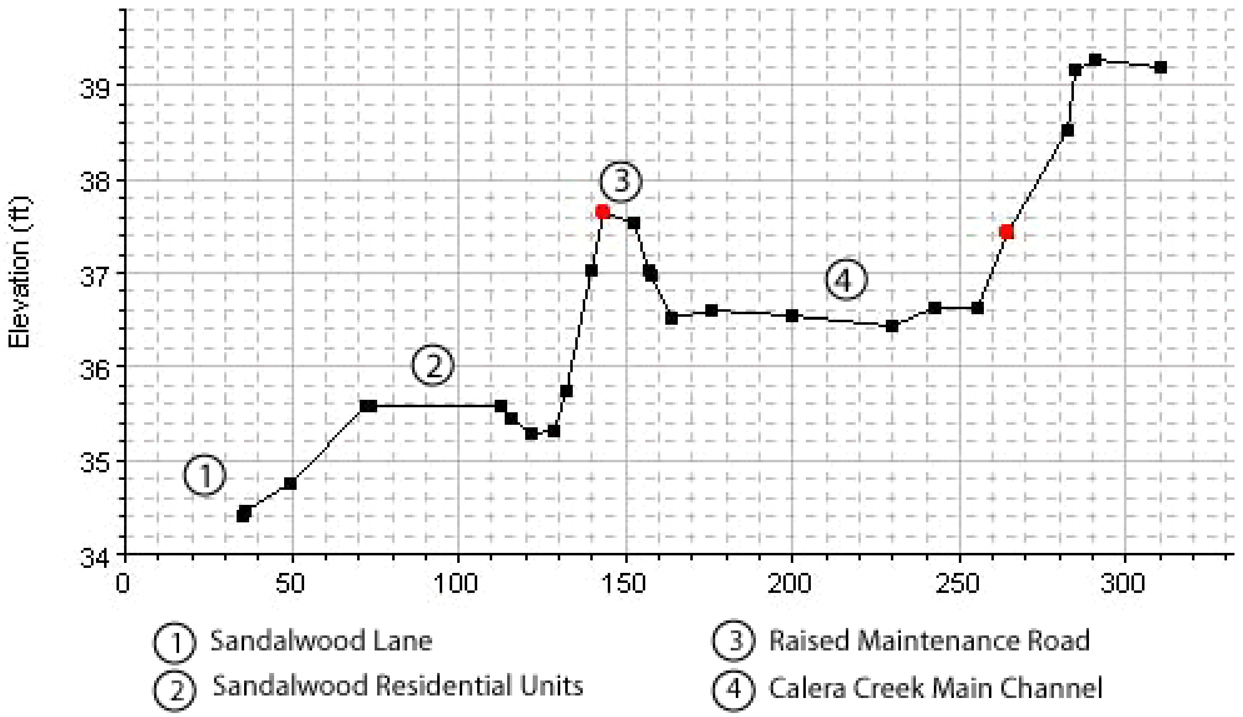


Figure 4: Cross section of Reach 5 of Calera Creek facing downstream at Station 37+53 (not to scale).

3.6 Reach 6: Escuela Parkway to Pedestrian Bridge (Station 41+00 to 53+20)

Two reinforced concrete box culverts approximately 170 feet long cross underneath Escuela Parkway. One culvert is 12 feet by 4 feet and the second is 10 feet by 4 feet. The reason the culverts are only four feet tall is that two San Francisco Public Utilities Commission Hetch Hetchy pipelines cross beneath the culverts. Field observations indicate that approximately one foot of sediment can accumulate at the downstream end of both culverts.

The upstream end of the box culverts has sacked concrete riprap around the inlet structure. Upstream of Escuela Parkway, Calera Creek is an earthen channel approximately 1,200 feet long within a 120-foot wide easement. The District has designated the section within 400 feet upstream of Escuela Parkway as a managed floodplain with a bottom width of 80 feet and 2:1 side slopes.

Approximately 400 feet upstream of Escuela Parkway, Calera Creek transitions to a narrow incised channel that runs along the south edge of the District's easement with little to no meander of the low flow channel. This subreach is designated a managed floodplain with a bottom width of 10 feet and 2:1 side slopes.

The upstream end of this reach is bounded by a 10-foot long, single 8-foot by 8-foot RCB culvert underneath a pedestrian bridge at station 53+20 (see Photograph 11 in Appendix D). This box culvert was free of sediment.

August 2001 field observations indicated that a large amount of sediment and thick plant growth had accumulated in the area within 100 feet upstream of Escuela Parkway (see Photograph 10 in Appendix D). In the event of a large flood, sediment and vegetation from this area could impede flow through the Escuela Parkway culverts and cause the creek to overtop its banks and continue as sheet flow to the south and west. District maintenance crews removed approximately 230 cubic yards of sediment in the summer/fall of 2001 (CRWQCB, 2001), returning the 100-foot area upstream of the culverts to nearly “As-built” conditions.

Hydraulic Analysis

Hydraulic modeling indicates that under existing conditions, the flooding within this reach is caused by the overtopping of the culverts at Escuela Parkway. The maximum flow that can be conveyed just prior to flow overtopping the culvert headwall is approximately 625 cfs. The flooding is caused by the inlet control conditions at the culverts, since the culvert opening area is not sufficient to pass the peak flow. Downstream water surface elevations are well below the top of the culvert and do not impact the flow rate. Continued sediment removal will be necessary upstream of the Escuela Parkway culverts to maintain a clear area to pass the flows. Sediment deposition will continue in this area due to the ponding that occurs upstream of the culverts.

The culvert capacity is limited primarily by the lower bank elevations on the left side (south side) of the channel near the culverts. The left bank is about three feet lower than the right bank at the headwall. If the left bank headwall was raised by about two feet, the culverts would pass the 1% event without overtopping. The left bank headwall would need to be raised by up to about 5.5 feet to provide 3.5 feet of freeboard during the 1% flow. A more costly alternative of adding an additional culvert under Escuela Parkway was not considered.

3.7 Reach 7: Pedestrian Bridge to Interstate 680 (Station 53+20 to 66+00)

The District easement for this reach is approximately 60 feet wide with a 10-foot wide maintenance road along the south bank of the creek. The channel is designed to have a bottom width of three feet with side slopes of 1.5:1 (District, 1993). The slope is significantly steeper (.028) than downstream reaches, and the higher water velocity has formed a narrow low flow channel with steep side slopes and little to no meander. Bushes and trees grow along the top of the creek’s banks. Some roots are visible extending out through the steep channel walls. A 500-foot long single 10-foot by 6-foot box culvert crosses under Interstate 680 (see Photograph 12 in Appendix D). There was approximately one foot of sediment evenly distributed along the culvert’s entire length.

Hydraulic Analysis

Hydraulic modeling indicates that the 1% flow is contained within the channel upstream of the Pedestrian Bridge. However, a flow of 425 cfs immediately upstream of the Pedestrian Bridge will create only one foot of freeboard at the bridge. Because of the restriction caused by the bridge, the 1% water surface elevation would rise above the surrounding ground along approximately 50 feet of channel immediately upstream of the pedestrian bridge. This would trigger the 4-foot freeboard requirement.along this short length of the creek. Accordingly, the bridge headwalls and levees within 100 feet upstream of the bridge would need to be raised an average of approximately 4 feet.

3.8 Reach 8: Interstate 680 to City Limits (Station 66+00 to 75+00)

From upstream of I-680 to the study limit, the slope of Calera Creek is approximately 0.037. Thick vegetation lines both banks outside of the main channel, which has similar characteristics to the reach immediately downstream of I-680. District maintenance personnel report that sediment removal in this area has not been necessary for at least the past 10 years. FEMA floodplain maps indicate that there is insufficient freeboard immediately upstream of I-680.

Hydraulic Analysis

This portion of the creek was not modeled as a part of this study.

3.9 Hydraulic Analysis Summary

A summary of the available capacity on Calera Creek by reach (assuming District freeboard criteria is achieved), the available freeboard at 920 cfs, and the necessary improvements to achieve the District's freeboard criteria is presented

Table 2: Summary of Hydraulic Analysis

Reach	Channel Capacity [1] (cfs)	Available Freeboard at 920 cfs (ft)	Proposed Improvements	Comments
1	800	3	Raise levees, floodwall by 0.5 to 2.5 ft.	
2	zero	zero	Raise height of U-frame by 2 feet along most of its length, and by 5 feet at the low point.	Water backed up from Berryessa would overtop the channel even with zero flow from Calera.
3	700	1.0	Raise levees approx 2.5 ft.	
4	650	0.5	Raise levees approx 3 ft.	
5	200	zero	Raise levee, build floodwall approx 3 ft in height.	
6	625	zero	Raise levee & headwall by up to 5.5 ft. immediately upstream of Escuela pkwy.	
7	650	zero	Raise headwall and levees an average of 4 ft within 100 ft upstream of bridge	

Notes:

1. Assuming channel or crossing conform to District's freeboard criteria

4. SCVWD WATERWAYS MANAGEMENT MODEL

The Waterways Management Model (WWMM) is a custom computer program which ranks capital flood protection projects among defined creek reaches. It is used as a tool for prioritization of capital improvement work performed by the District. The number one ranking criteria, which has a weight of 50% among nine other criteria, is the dollar value of estimated annual damages that would be prevented by improvement of the reach. Within the model, Calera Creek is divided into three reaches:

4018-01: Berryessa Creek to Escuela Parkway
4018-02: Escuela Parkway to Upstream of Park Victoria Drive (Upstream of I-680)
4018-03: Upstream of Park Victoria Drive to Limit of Jurisdiction

Only the first reach (4018-01) is recognized as having flood damages and is ranked #18 out of 71 other reaches within the East Zone. According to the model, the damages for a 100-year flood event are $4,367,000 with average annual damages of $227,000. The remaining two reaches of Calera Creek (4018-02 & 03) rank #67 & #66 respectively. Both have 0 values for 100-year flood event and average annual damages.

The WWMM is undergoing a revision and updating process. Information within the model that is specific to Calera Creek may not accurately represent existing conditions.

5. MAINTENANCE HISTORY

Periodic maintenance has been performed by District staff as detailed in Table 3, though some of the flooding problems can not be mitigated by conducting routine maintenance.

Table 3: Average Historic Periodic Maintenance Activities, Fiscal Years 1990-1998

Activity No.	Description	Average Frequency
1010	Sediment and Debris Removal – IN CHANNEL	Once a year
3010, 3100	Pre-Emergent Herb – Mechanical, Chemical, Hand	Twice a year
3060, 3110	Tree Removal	Once every 3 years
3080, 3090	Vegetation/Woody/Weed Control – IN CHANNEL	Twice a year
3150	Misc. Vegetation/Weed Control – Stomp Tules	Once every 4 years

6. CONCLUSIONS

The following summarizes corrective measures that would provide 1% flood protection with freeboard.

6.1 Reach 1

The recent Calera Creek Floodwalls and Access Bridge Project provides approximately three feet of freeboard, though to comply with the District standard of 3.5 feet of freeboard, the levees and floodwalls should be raised by 0.5 to 2.5 feet depending on the varying elevations of existing structures..

6.2 Reach 2

This reach cannot convey the 1% flow within the channel without overtopping where the wall height of the rectangular reinforced concrete U-frame channel decreases from 12 feet to 9 feet downstream of North Milpitas Boulevard The analysis indicates that the wall along the entire length of the U-frame should be raised to 14 feet in height.

6.3 Reaches 3 and 4

These reaches can convey the current 1% flow within the channel without overtopping, though lack sufficient freeboard. Raising of the levees would solve this problem. The minimum increase in levee height in Reach 3 is 2.5 feet and in Reach 4 is 3 feet.

6.4 Reach 5

Reach 5 lacks adequate conveyance capacity due to the backwater effect caused by the narrow entrance to the drop structure. This problem could be fixed by modifying the drop structure and/or raising the levee along the south side of the channel by 3 feet and building a floodwall of approximately the same height along the north side of the creek.. Additional maintenance of the channel may be required to provide 3.5 feet of freeboard in upper portion of the reach that is not affected by the drop structure backwater.

6.5 Reach 6

Reach 6 lacks adequate conveyance capacity due to headwater requirements at the Escuela Parkway culverts and insufficient headwall/bank height on the left side of the channel. Increasing the headwall height by approximately five feet would provide 3.5 feet of freeboard at the 1% flow rate.

6.6 Reach 7

Reach 7 lacks adequate conveyance capacity due to flow constrictions at the Pedestrian Bridge culvert and insufficient headwall and bank height. Increasing the headwall and bank height by up to 4 feet (a lesser increase is needed further upstream) will provide adequate freeboard for the 1% flow rate. Further analysis is required since the modeling was based on assumed elevation and culvert dimension values.

References

1. Santa Clara Valley Flood Control and Water District: Reports on Calera Creek, Quimby Creek, and Fowler Creek. June, 1969

2. Santa Clara Valley Flood Control and Water District: Appendix of the East Zone Planning Study. 1973

3. Santa Clara Valley Water District: Maps of Flood Control Facilities and Limits of 1% Flooding ("Yellow Book"). June, 1993

4. Federal Emergency Management Agency: Flood Insurance Study, City of Milpitas, California. Santa Clara County. January 10, 1996

5. Santa Clara Valley Water District: Urgent Sediment Removal Projects: Clearances. August 27, 1997

6. Santa Clara Valley Water District: Report on Flooding and Flood Related Damages in Santa Clara County, February 2 to 9, 1998. 1998

7. Santa Clara Valley Water District: Engineering-Based Maintenance Guidelines: East Flood Control Zone. 1998

8. Schaaf & Wheeler: California Landing Flooding, February 3,1998. Flooding Evaluation Study. August 26, 1998

9. Santa Clara Valley Water District: Calera Creek Floodwalls Project – Draft Initial Study and Negative Declaration. December 28, 2000

10. Santa Clara Valley Water District Maintenance Department: Ken McKenzie – Telephone interview. June 20, 2001

11. California Regional Water Quality Control Board – San Francisco Bay Region: Tentative Order, Waste Discharge Requirements and Water Quality Certification For: Santa Clara Valley Water District, 2001 Sediment Removal Project, Santa Clara County. July 2001

Appendix A

Chronology of Calera Creek

June 10, 1969	Engineer’s report describing structural improvements to the channel.
January 23, 1973	City of Milpitas Report describes widening of Main Street (now North Milpitas Boulevard) and the construction of a new culvert. “Calera Creek will be widened ultimately by the District)
September 6, 1973	East Zone Planning Study, which addresses Calera Creek as SCVWD East Flood Control Zone E-1 Project 40018. Calera Creek from Berryessa Creek to 155 feet upstream of route 680. Realignment of Calera Creek to run adjacent to Jacklin Road, underneath North Main Street and SP/WP RRs to confluence with Berryessa Creek. Plans show double box culvert under the two railroad tracks and an ‘outlet confluence structure’ apparently with floodwalls at elevation 16.0 downstream of the railroad. Culvert invert elevation at 6.4 at downstream. Planning study – not ‘as built’
February 20, 1975	District Memo “…investigating alternatives on Calera Creek between the Southern Pacific Railroad and Western Pacific Railroad and Main Street because Chappell [sic] is planning a development east of Main Street and because Milpitas is planning to rebuild the culvert on Main Street…” “Since the District has no funds … City of Milpitas would have to come up with the funds…” “Regarding Chappell [sic], it would seem their development would cause increased flooding on the downstream property since there is no proper outfall and that their property should not be developed unless they can demonstrate that their development will not increase downstream flooding.
July 1, 1975	District Report Engineer’s Report for Berryessa Creek Improvement from Lower Penitencia Creek to Calaveras Boulevard. “The proposed improvements, when constructed, will prevent major flooding in the floodplain areas of Berryessa Creek between the Sinclair Freeway (Interstate 680) and Main Street (North Milpitas Boulevard) and between Jacklin Road and Calaveras Boulevard.” The 100-year flood map did not show any area north of Jacklin Road. The engineering drawings showed levee construction similar to what exists today but plans provided no details on connection to Calera Creek.
July 1975	District Report Final EIR for Proposed Berryessa Creek Flood Control Project from Lower Penitencia Creek confluence to Calaveras Boulevard. Prepared by Woodward-Clyde Consultants for the Santa Clara Valley Water District. The 100-year flood map was same as in Engineer’s Report, i.e., south of Jacklin Road, south of Calera Creek. The report describes City of Milpitas receiving initial flood hazard boundary maps from the Federal Emergency Management Agency (FEMA) in

	March 1974 which showed all land within city west of Interstate 680 to be flood prone. ‘The waters which potentially could flood this land would come from Calera and Coyote Creeks, as well as Berryessa Creek.’ Report described levee project with a substantial floodgate facility … at the confluence of the excavated channel and Calera Creek, so that local drainage can be released into the flood facility.” There were no plans showing the ‘floodgate facility’ in the EIR or Engineer’s Report. The EIR also included the following section under the Hydrology Impacts section: “The improved channel will convey runoff somwhat more rapidly than the present channel. During periods of high flow this could cause some increase in the flooding downstream (i.e., below the point where Berryessa Creek meets with Lower Penitencia Creek). Because there is currently little development in this downstream area, neither the areal extent nor the severity of this additional increment in flooding has been computed in detail. However the Water District believes that the potential increase in property damage would be minor. Subsequent improvement of downstream reaches will, of course, mitigate those problems. During periods of high stream flow in Berryessa Creek, all of the other creeks in the area will also be conveying high flows. The flow from Berryessa will undoubtedly raise the stage in Tularcitos and Calera Creeks and add to the load on Penitencia and Coyote Creeks. However, similar conditions have occurred for many years and must be expected to occur indefinitely, primarily because of the flat terrain. Hence, the interference of Berryessa Creek with other creeks will probably be only slightly increased by the proposed channel modifications.’
August 5, 1975	Bissel and Karn Letter to the City of Milpitas. Summary of analysis on flooding impacts downstream of Shapell development for a 100-year flood downstream of the proposed double 10’x8’ concrete box under N. Main Street (North Milpitas Boulevard) to the WPRR (UPRR). Evaluation assumes no improved outfall channel for Calera Creek downstream of WPRR. “…improvements upstream of relocated North Main Street (North Milpitas Boulevard) without the outfall channel will not significantly change the existing flooding conditions downstream.”
January 11, 1977	District memo. Discussion of having developer (Chappell) [sic] construct the Calera Creek improvements from Berryessa Creek to Main Street.
January 24, 1977	City of Milpitas Letter to District. Transmitted California Environmental Quality Act (CEQA) document which addressed “…the widening of Calera Creek between Milpitas Boulevard and the Berryessa channel…” “Please advise… so that we may proceed with the design and construction…”
May 12, 1977	City of Milpitas Letter to District. “City of Milpitas is pursuing the construction of Calera Creek between Main Street and Berryessa Creek.”

	"The developer was not interested in pursuing design and construction at this time." The City of Milpitas requested the District proceed with plans and contract construction.
August 4, 1977	District Letter to City of Milpitas Discussion of cost review of SPRR crossing for Calera Creek. "First, the existing railroad bridges are timber pile bridges that are probably more than 50 years old. Neither railroad company will allow us to modify these structures. The railroad engineers feel that the structural integrity of these bridges would be jeopardized." "Second, the existing Southern Pacific bridge is below the one percent water surface elevation. Even if the bottom of this bridge was lowered by many feet, the water surface elevation would still be above the soffit of the bridge. The water surface is controlled by the depth of flow in Berryessa Creek."
December 2, 1977	District "Green Book" of revised 1% flows released.
July 1983	Second culvert barrel added to Escuela Parkway
July 1, 1991	FEMA Letter to City of Milpitas Regarding CLOMR application for California Landing. "We believe that, if the proposed levee improvements … are constructed … then the east levee will provide protection from the 100-year flood…" (East levee on Lower Penitencia Creek.)
December 11, 1996	District Letter to City of Milpitas. Regarding the proposed revisions to the Flood Insurance Rate Map (FIRM) for Berryessa and Calera Creeks. District committed to restore Berryessa levees to As-Built condition. Calera Creek would require a capital improvement to raise portions of the levees.
July 10, 1997	FEMA Letter to City of Milpitas FEMA study contractor found that existing levees from Calera and Berryessa Creeks did not have required freeboard. Requests City of Milpitas submit appropriate FEMA forms for remedial levee work within 30 days.
February 3, 1998	California Landing flooding. Partial flooding of Milpitas High School.

Appendix B

Cost Estimate

Description	Cost - % of	General	Estimated Cost by Alternative									Total Cost	
Type of Costs	Construction	Costs	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5a	Reach 5b	Reach 6	Reach 7	Reach 8	Option A	Option B
Planning	10%		$8,100	$11,600	$51,600	$30,400	$196,000	$157,200	$13,400	$4,800		$316,000	$277,000
Design	30%		$24,300	$34,800	$154,800	$91,200	$588,000	$471,600	$40,200	$14,400		$948,000	$831,000
Construction Cost	100%		$81,000	$116,000	$516,000	$304,000	$1,960,000	$1,572,000	$134,000	$48,000	$0	$3,159,000	$2,771,000
CM/SDC/Inspection	12%		$9,720	$13,920	$61,920	$36,480	$235,200	$188,640	$16,080	$5,760		$379,000	$333,000
CEQA/Permitting	(LS)	$150,000										$150,000	$150,000
ROW	(LS)		$0	$0	$0	$0	$0	$0	$0	$0	$0		
Total		**$150,000**	**$123,000**	**$176,000**	**$784,000**	**$462,000**	**$2,979,000**	**$2,389,000**	**$204,000**	**$73,000**		**$4,952,000**	**$4,362,000**

Appendix C

Results of Calera Creek Hydraulic Modeling

Memorandum

RMC
Raines, Melton & Carella, Inc.

To:	Eric Evans
Prepared by:	Jeff Lewandowski
Reviewed by:	Eric Evans
Date:	September 2, 2003
Revised by:	Eric Evans
Revision Date:	April 6, 2004
Subject:	Calera Creek HEC-RAS Analysis

Summary

Based on HEC-RAS modeling results, the existing Calera Creek flow design capacity under District freeboard guidelines varies from a maximum of about 900 cubic feet per second (cfs) to less than 200 cfs. These capacities are less than the current FEMA 100-year flow rate for the creek of 920 cfs, and also less than the pre-1978 design flow of 750 cfs. The as-built and existing design capacities are generally the same, except for the reach between the drop structure and Escuela Parkway. In this reach, the as-built levee heights on both sides of the channel were slightly higher than those measured in the recent survey of the area. Also, sediment deposition up to approximately three feet deep and heavy plant and tree growth have further reduced carrying capacity in this reach. The higher as-built levee elevations in this reach allowed a greater depth of flow and a 300 cfs design capacity with freeboard under the as-built conditions, compared with less than 200 cfs design capacity with freeboard at existing conditions.

The downstream leveed reaches between Berryessa Creek and the drop structure cannot convey the 1% flow of 920 cfs without overtopping the channel. The freeboard guidelines require 3.5 feet of freeboard in these sections. The channel reaches between the drop structure and I-680 can carry between 625 and 750 cfs before overtopping occurs.

Overtopping occurs first downstream of N. Milpitas Blvd due to a 90-foot length of U-frame channel that is 3 feet lower than the 12 foot height of the remaining 1,000 feet of this structure. The water surface elevation of Berryessa Creek would “back up” into this area and cause overtopping even if the flow from Calera Creek were zero. Further overtopping occurs upstream of the drop structure and upstream of the culvert crossings at Escuela Parkway and the Pedestrian bridge. Capacities of these reaches can be increased to 920 cfs with revisions of the drop

structure and/or the levees upstream of the drop structure, and increases in the upstream bank elevation near the culvert crossings at Escuela Parkway and the Pedestrian Bridge. The channel capacities within the individual reaches upstream of the drop structure and culvert crossing are generally adequate to carry the 920 cfs flow since these reaches are very steep.

Project Approach

The results from two models of Calera Creek were compared to determine the as-built channel capacity and the existing channel capacity. The as-built model channel cross sections were developed from the design plan drawings for the channel construction. Elevations from the plans were adjusted to the NAVD 88 datum. Plan drawings for the Pedestrian Bridge upstream of Escuela Parkway were not available, and channel and culvert geometries were estimated for the model.

The existing condition model was developed by surveying selected portions of the channel, and substituting those cross sections for the as-built cross sections. Survey information was limited to two sections. One section included 100 feet of channel length downstream of N. Milpitas Boulevard. The second section included 1,300 feet upstream of the channel drop structure near the high school including 200 feet upstream of Escuela Parkway.

Calera Creek was modeled between the confluence with Berryessa Creek and I-680. Results presented by this analysis are based upon computer simulation and should be considered as approximate. Designations of left and right are as seen facing downstream.

Downstream Boundary Condition

The Berryessa Creek 100-year water surface elevation at the Calera Creek confluence is16.0 feet NGVD 29 based upon the Calera Creek Floodwalls and Access Bridge Engineer’s Report (2001). This elevation + 2.75 feet datum correction was used to obtain the starting water surface elevation of 18.75 feet NAVD88 for this study.

Modeled Flow Conditions

The designated 1% flow of Calera Creek at the time of its original design and construction is 720 cfs between I-680 and Escuela Parkway, and 750 cfs between Escuela Parkway and the confluence with Berryessa Creek. The 100-year flood flow from the FEMA Flood Insurance Study (FIS) for Milpitas dated 1998 was listed as 920 cfs for flows downstream of I-680. Seventeen different flow rates ranging from 200 to 950 cfs were used in the model to determine the creek water level under each flow rate for comparison with minimum SCVWD freeboard guidelines.

Minimum Freeboard Guidelines

Calera Creek has reaches of leveed and unleveed channels as listed in Table 1. The freeboard requirements are based on the relative elevation of the design water surface with the natural ground. When the design water surface is above the natural ground, the freeboard requirement is 3.5 feet in the channel and 4 feet at bridges or channel constrictions. When the design water surface is below the natural ground, the required freeboard is 1 foot in the channel. The freeboard must be increased to 0.2 x specific energy when this value is larger than the required freeboard. The design capacity of the channel in both the existing and as-built conditions was based on the design water depth meeting the minimum freeboard guidelines at every cross section in the reach. The areas of each reach where freeboard was at a minimum are listed on Table 1. For this analysis, all levee sections were assumed to have a design water surface above the natural ground.

Table 1. Calera Creek Channel Reach Descriptions

Reach	Approximate Length (feet)	Channel Type	Minimum Freeboard Guidelines[1]	Location of Minimum Freeboard
SPRR to N. Milpitas Blvd	550	Leveed – Floodwalls	3.5 feet or 0.2 x Specific Energy	Notch in wall near N. Milpitas Blvd.
N. Milpitas Blvd to Arizona Dr.	1,400	Leveed – Berms	3.5 feet or 0.2 x Specific Energy	Near Arizona Dr.
Arizona Dr. to Drop Structure	800	Leveed	3.5 feet or 0.2 x Specific Energy	Near Drop Structure
Drop Structure to Escuela Parkway	950	Leveed – Berms	3.5 feet or 0.2 x Specific Energy	Backwater at Drop Structure
Escuela Parkway to Pedestrian Bridge	1,150	Leveed within 100 feet upstream of constriction, unleveed elsewhere	1 feet or 3.5 feet or 0.2 x Specific Energy	Backwater at Escuela Parkway
Pedestrian Bridge to I-680	1,050	Leveed within 100 feet upstream of constriction, unleveed elsewhere	1 feet or 3.5 feet or 0.2 x Specific Energy	Backwater at Pedestrian Bridge

1 Use maximum of the two values listed.

General Model Results

A profile of Calera Creek under flow conditions of 700 cfs is shown on Figure 1. The stream hydraulic conditions are different for flow upstream and downstream of the drop structure near the high school. Upstream of the drop structure, the channel is steep with flow in supercritical conditions in some locations. Downstream of the drop structure, the channel is relatively flat with subcritical flow.

In the upstream section, design flow rates are determined by the capacity of the culvert crossings and the drop structure. Hydraulic jumps and subcritical flow occur just upstream of the culvert crossings at the Pedestrian Bridge and at Escuela Parkway. At both culvert crossings, upstream water surface is based on inlet control of flow through the culverts. A pool is formed upstream of the drop structure and the flow passes through critical depth at the drop structure spillway. The high water levels in these pools create the minimum freeboard in the channel in these reaches. The channel capacities within the individual reaches upstream of the drop structure and culvert crossing are generally adequate to carry the 920 cfs flow since they are very steep.

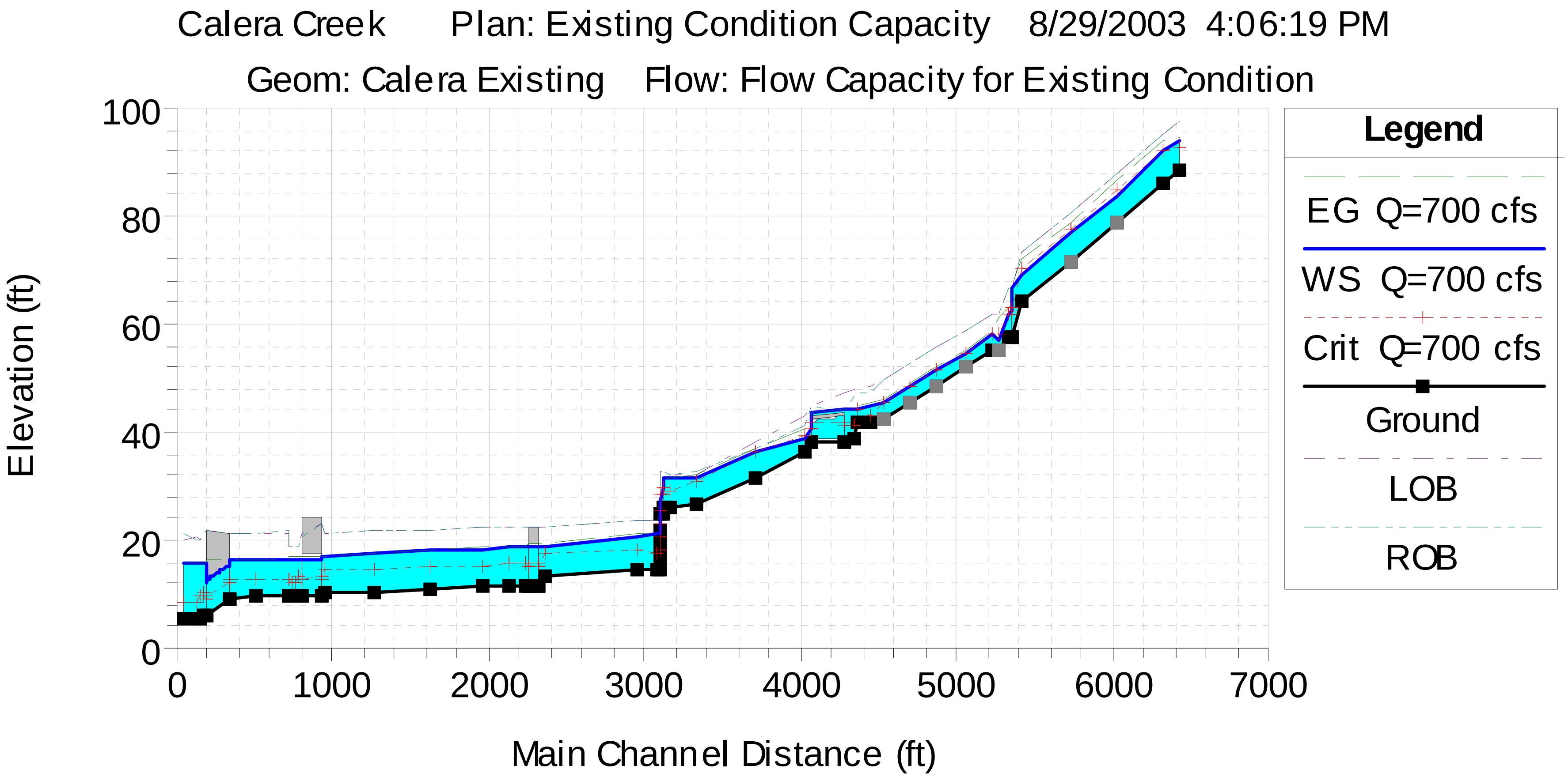

Calera Creek Plan: Existing Condition Capacity 8/29/2003 4:06:19 PM
Geom: Calera Existing Flow: Flow Capacity for Existing Condition
Elevation (ft)
100
80
60
40
20
0
0
1000
2000
3000
4000
5000
6000
7000
Main Channel Distance (ft)
Legend
EG Q=700 cfs
WS Q=700 cfs
Crit Q=700 cfs
Ground
LOB
ROB

Figure 1.

Downstream of the drop structure, design flow rates are determined by freeboard along the length of the channel instead of the flow pool upstream of the culvert crossings. The water surface in this portion of the creek is dependent on either the normal depth in the channel or the water surface elevation in Berryessa Creek. The culverts at Arizona Drive and N Milpitas Boulevard are wide enough to pass the flow under inlet control conditions with little head loss. The UPRR culvert crossing is fully submerged at the 100-year water surface in Berryessa Creek and flows under outlet control.

Existing Capacity Analysis

The capacity under existing conditions for each of the channel reaches are listed in Table 2. The overtopping capacity was defined as the peak flow that can pass through a given reach without causing the water level to exceed the lowest overbank location within a reach.

Table 2. Existing Channel Geometry Flow Capacity

Reach	Channel Type	Freeboard Amount	Overtopping Capacity[a] (cfs)
UPRR to N. Milpitas Blvd	Leveed – Floodwalls	3.5 feet	Zero due to backwater from Berryessa Creek.
N. Milpitas Blvd to Arizona Dr.	Leveed – Berms	3.5 feet	Greater than 920
Arizona Dr. to Drop Structure	Leveed – Berms	3.5 feet	Greater than 920
Drop Structure to Escuela Parkway	Leveed – Berms	3.5 feet	750
Escuela Parkway to Pedestrian Bridge	Leveed within 100 feet upstream of constriction, unleveed elsewhere	4 feet, 1 foot	625
Pedestrian Bridge to I-680	Leveed within 100 feet upstream of constriction, unleveed elsewhere	4 feet, 0.2 x Specific Energy (1.5 ft)	650

a Overtopping Capacity based on flow depth at top of bank

The range of design capacity of the channel varies from less than 200 cfs to the 100-year flow rate of 920 cfs. Within the reach between the UPRR and N. Milpitas Boulevard, the design capacity cannot be determined since the 100-year water surface elevation in Berryessa Creek with no flow in Calera Creek causes overtopping at the notched section in the concrete wall near N. Milpitas Boulevard.

The design capacity of the reach between the drop structure and Escuela Parkway is less than 200 cfs due to the low levees and the required minimum freeboard of 3.5 feet. The 450 cfs existing capacity of the reach between Escuela Parkway and the pedestrian bridge is higher, since only one foot of freeboard is necessary at the minimum freeboard location just upstream of Escuela Parkway. Upstream of the pedestrian bridge, depths of flow are greater than five feet and the freeboard of 0.2 x specific energy controls the design capacity. The 425 cfs capacity was based on the culvert size and assumed channel bank heights.

The overtopping capacities of all reaches are greater than the existing capacities, and in some cases exceed the current 100-year flow rate. Between Berryessa Creek and the drop structure, the current 100-year flow can be conveyed with about 1.5 feet freeboard. Upstream of the drop structure, the overtopping capacity is 750 cfs and is based on the flood pool created upstream of the drop structure. Modifications to the drop structure that reduce the pool level or raising the levees to accommodate the pool could increase capacity to 920 cfs. Overtopping capacity for the reaches upstream of Escuela Parkway is based on the flow capacity of the culvert crossings. The overtopping capacity at Escuela Parkway could be increased from 625 cfs to 920 cfs by increasing the elevation of the left bank by about two feet. The left bank is about three feet lower than the right bank near Escuela Parkway. Design details for this improvement are provided on drawing plans[3] dated 1976, but were never constructed. The overtopping capacity of the pedestrian bridge was estimated to be about 650 cfs based on assumed channel bank heights.

As-Built Capacity Analysis

The design capacity under the as-built conditions for each of the channel reaches is listed in Table 3. The as-built and existing design capacities are generally the same, except for the reach between the drop structure and Esquela Parkway. In this reach, the as-built levee heights on both sides of the channel were slightly higher than those measured in the recent survey of the area. These higher as-built levee elevations allowed a greater depth of flow and greater capacity under the as-built conditions.

Table 3. As-Built Channel Geometry Flow Capacity

Reach	Channel Type	Freeboard Control	As-Built Capacity[a] (cfs)	As-Built Overtopping Capacity[b] (cfs)
UPRR to N. Milpitas Blvd	Leveed – Floodwalls	3.5 feet	Cannot be determined [c]	Greater than 920 (1.5 feet freeboard)
N. Milpitas Blvd to	Leveed –	3.5 feet	750	Greater than 920

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[3] Standard Details for the Improvement of Tract No. 5976, City of Milpitas, California, Sheet Number 8 of 8 Sheets.

Arizona Dr.	Berms			(2.8 feet freeboard)
Arizona Dr. to Drop Structure	Not Leveed	0.2 x Specific Energy (1.5 ft)	900	Greater than 920 (1.4 feet freeboard)
Drop Structure to Escuela Parkway	Leveed – Berms	3.5 feet	300	920
Escuela Parkway to Pedestrian Bridge	Not Leveed	1 feet	450	625
Pedestrian Bridge to I-680	Not Leveed	0.2 x Specific Energy (1.5 ft)	425	650

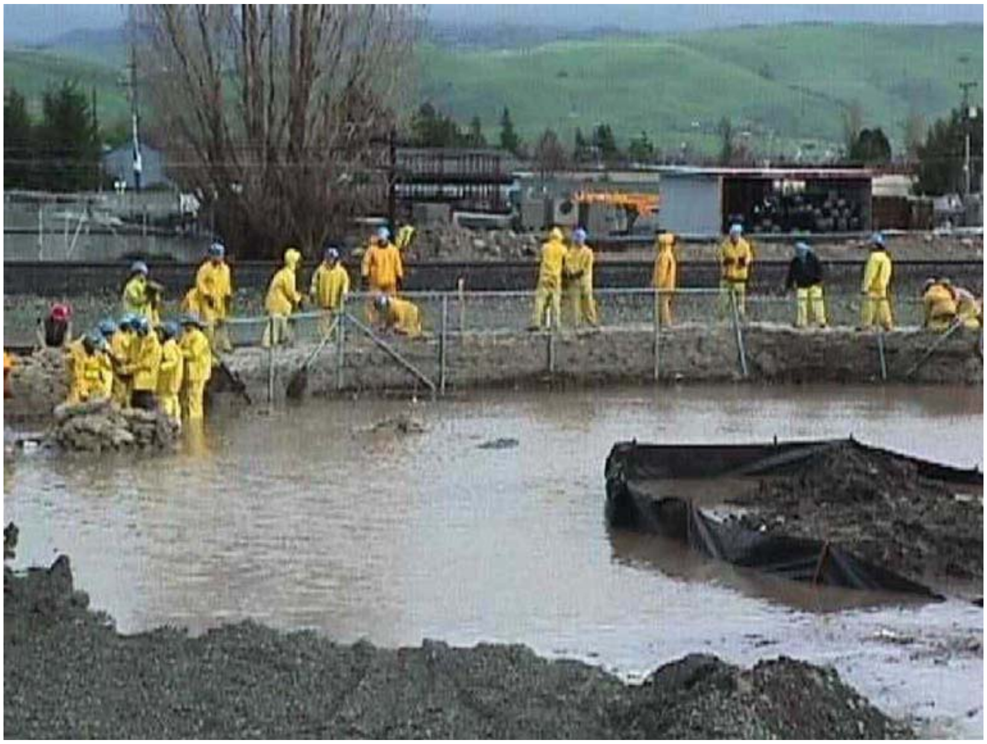
a Design Capacity based on flow depth at minimum freeboard guidelines listed in Freeboard Control column

b Overtopping Capacity based on flow depth at top of bank . If overtopping capacity is greater than the 100-year flow rate of 920 cfs, the freeboard at 920 cfs is listed.

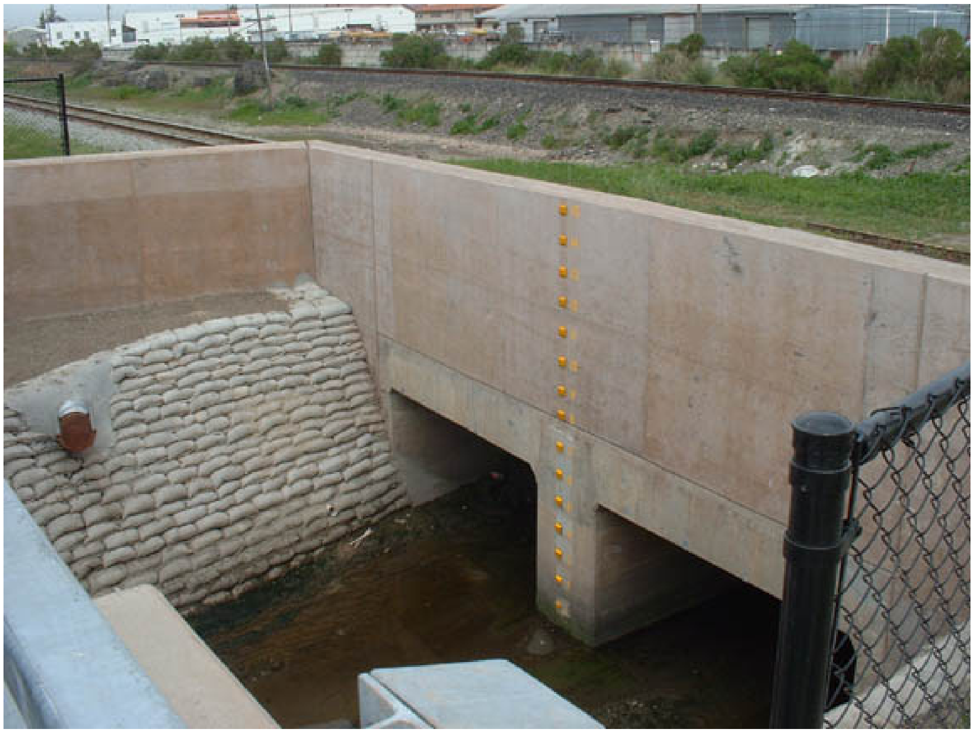
c 100-year water surface elevation in Berryessa Creek creates freeboard conditions less than 3.5 feet

Appendix D
Photographs

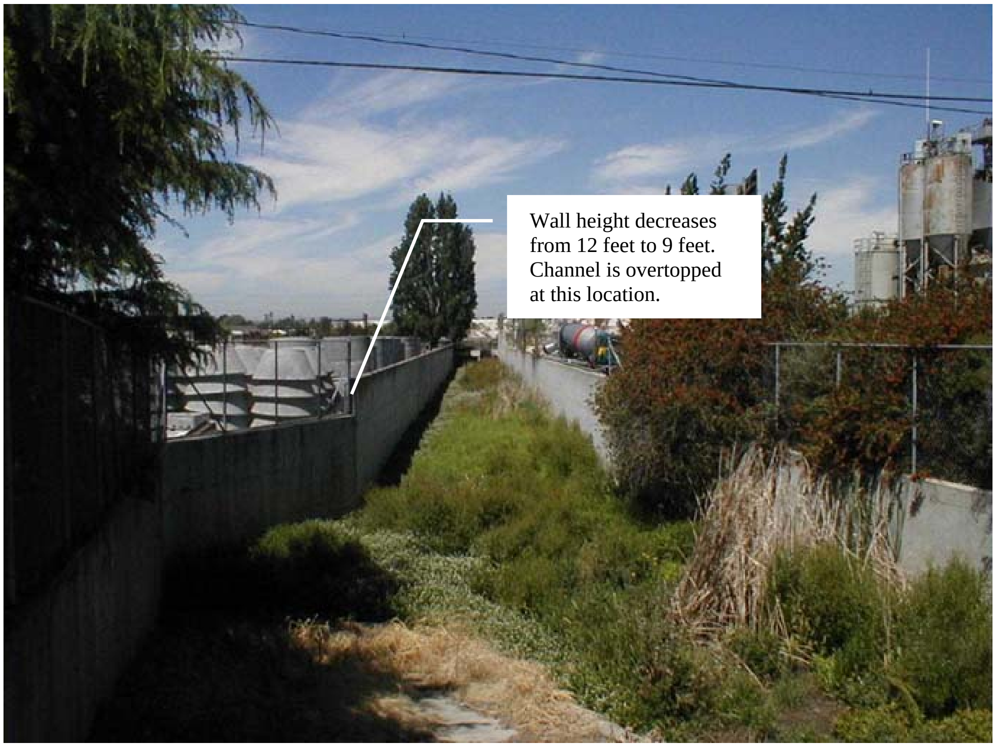
Photograph 1: Flooding in Reach 1 as seen from the Berryessa Creek confluence, 1998



Photograph 2: Berryessa Creek to UPRR Crossing from Station 1+50



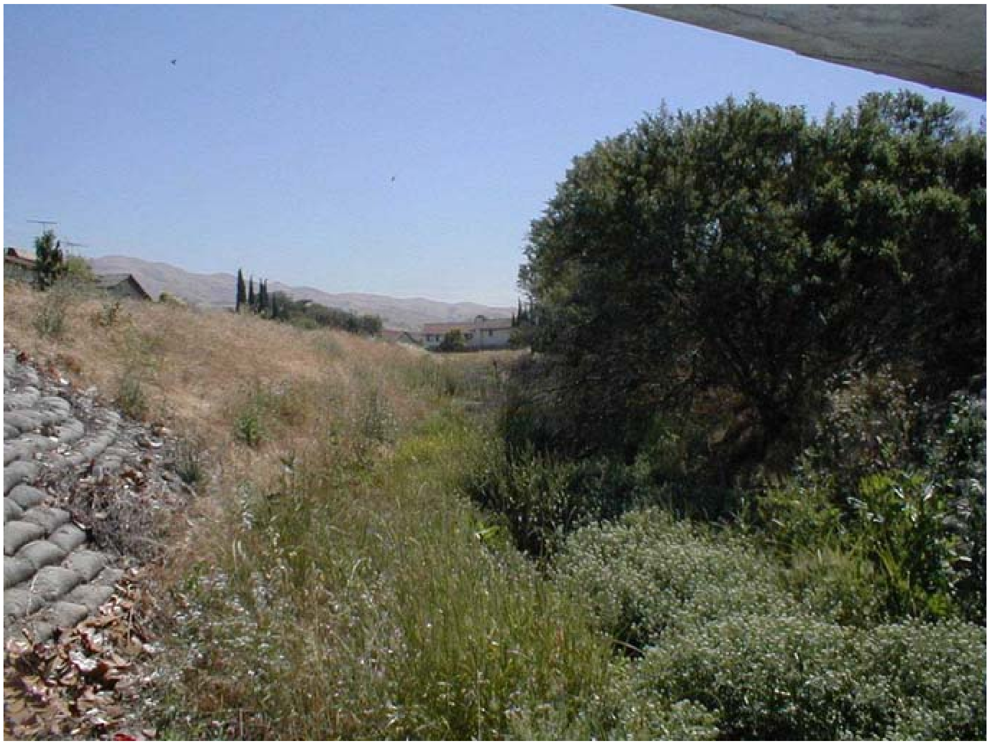
Photograph 3: North Milpitas Boulevard to UPRR facing downstream from Station 7+80



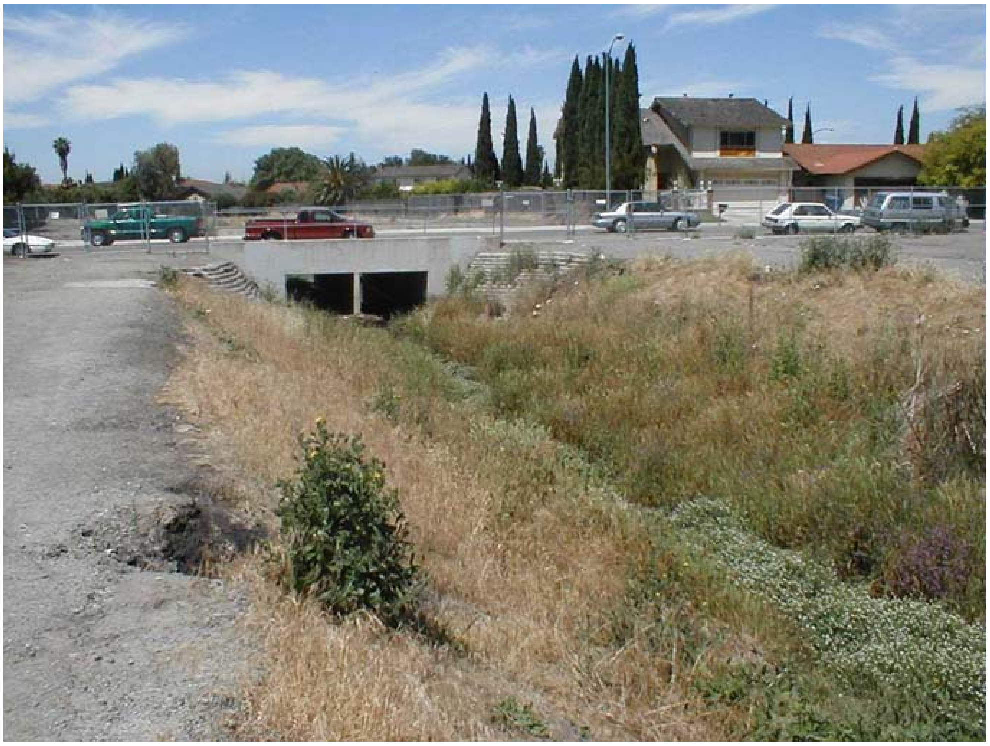
Wall height decreases from 12 feet to 9 feet. Channel is overtopped at this location.

Photograph 4: UPRR to North Milpitas Blvd facing U/S from Station 7+80

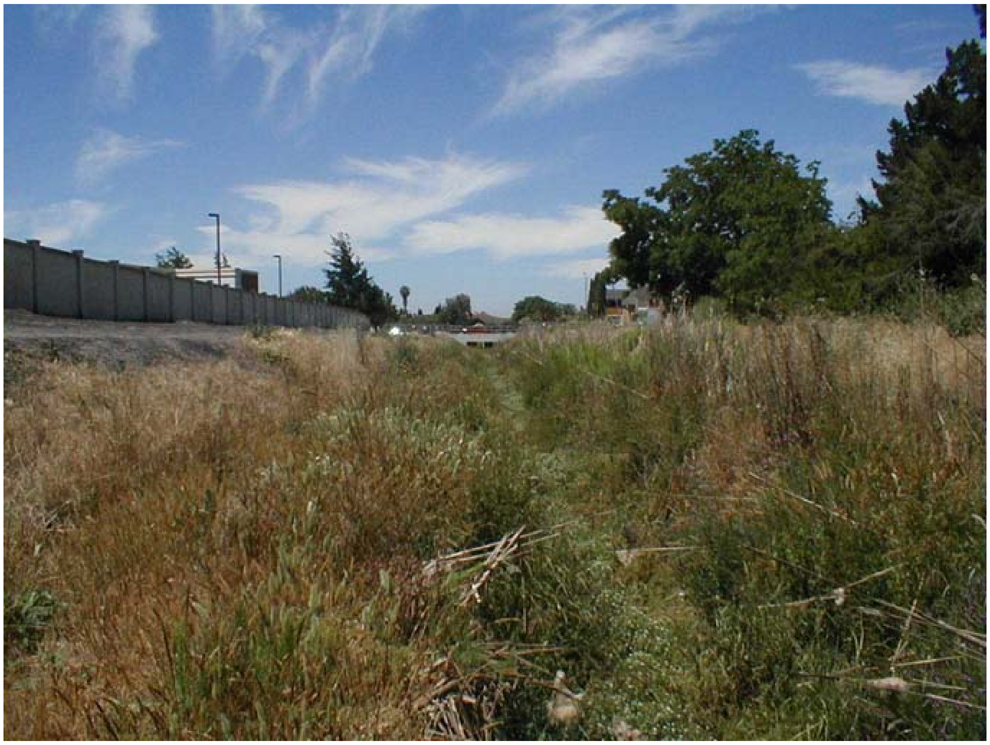
Photograph 5: North Milpitas Blvd. to Arizona Ave. facing U/S from Station 9+10



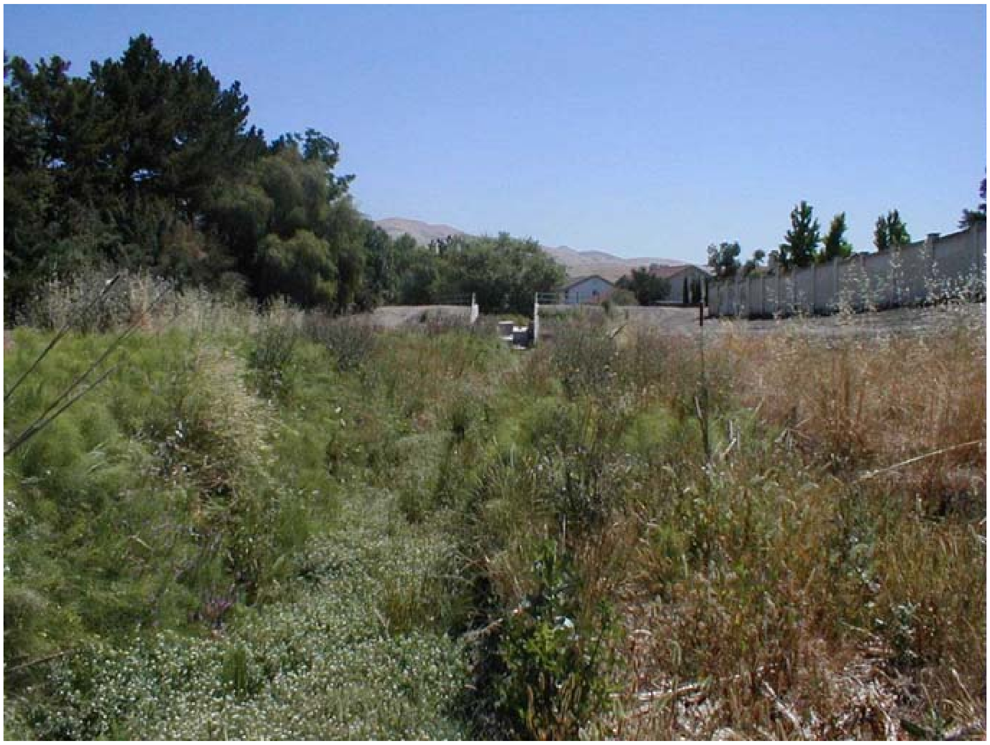
Photograph 6: Arizona Ave. to Drop Structure facing D/S from Station 24+50



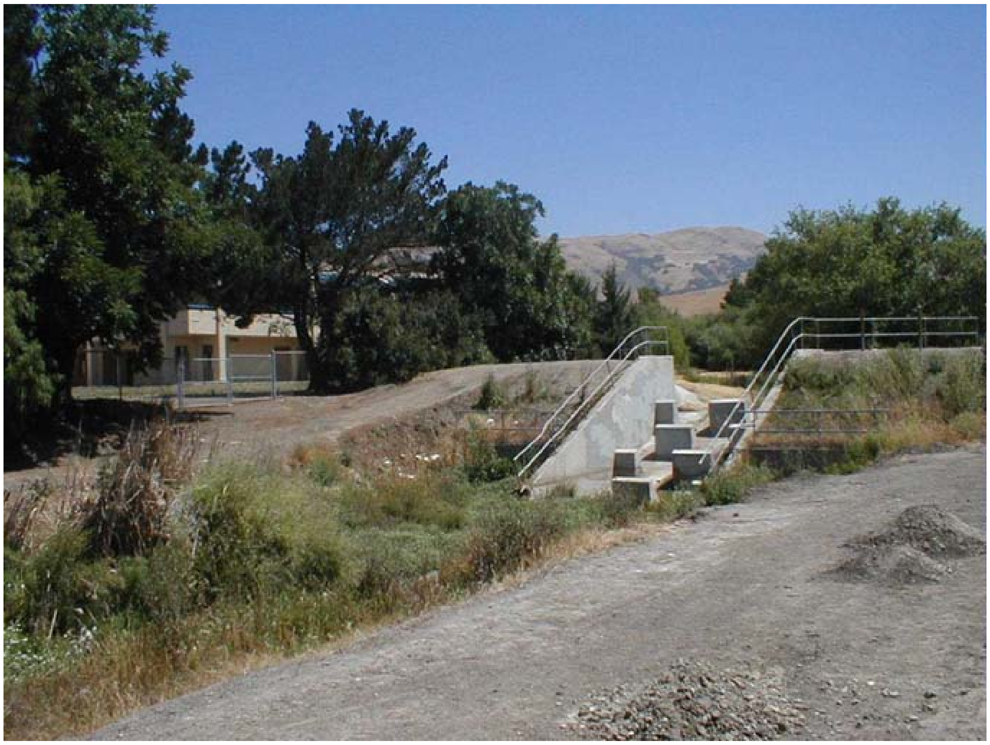
Photograph 7: Arizona Ave. to Drop Structure facing D/S from Station 29+00



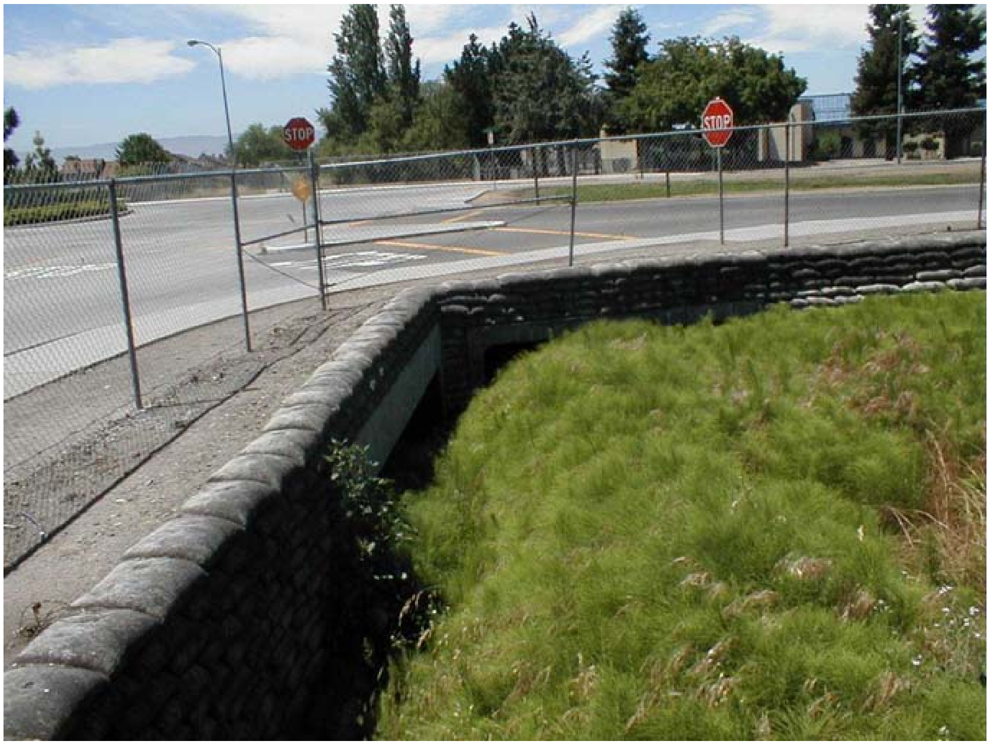
Photograph 8: Arizona Ave. to Drop Structure facing U/S from Station 27+50



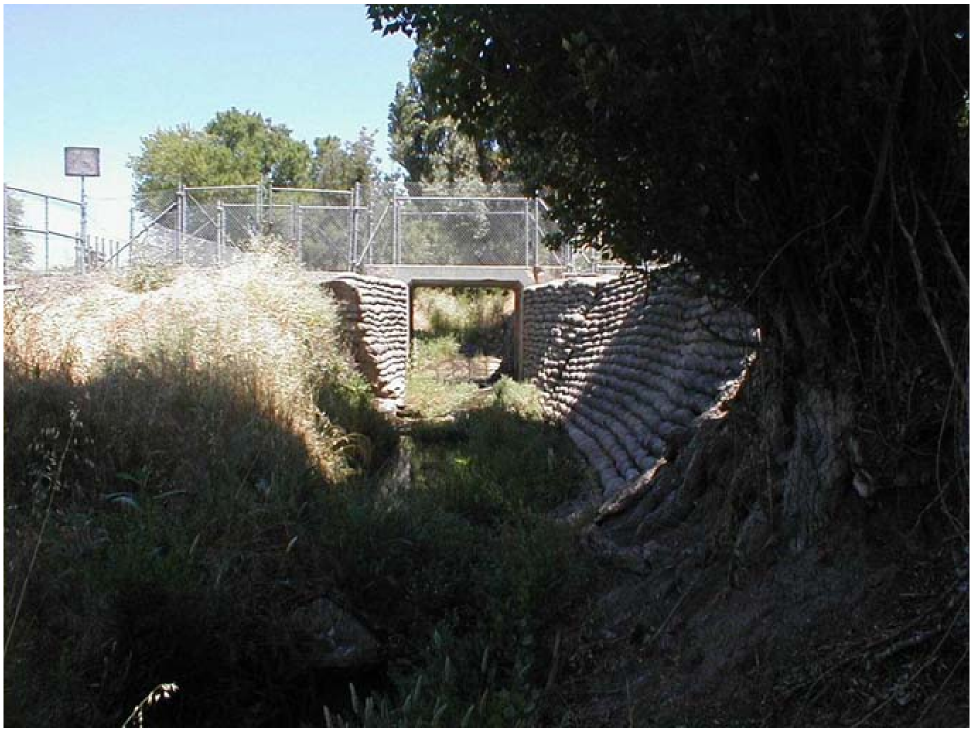
Photograph 9: Drop Structure facing U/S from Station 30+00



Photograph 10: Escuela Parkway inlet structure facing D/S from Station 43+20



Photograph 11: Pedestrian Bridge facing U/S from Station 52+50



Photograph 12: Interstate 680 Culvert facing U/S from Station 63+00